

REMARKS

Favorable reconsideration is respectfully requested.

The claims are 41-55.

A new set of claims are presented in which, claim 41 replaces previous claim 29.

New claim 42 replaces previous claim 30 and is dependent on new claim 41.

New claim 43 replaces previous claim 32 and is dependent on new claim 41.

New claim 44 replaces previous claim 33 and is dependent on new claim 41.

New claim 45 replaces previous claim 36 and is dependent on new claim 41.

New claim 46 replaces previous claim 37 and is dependent on new claim 41.

New claim 47 replaces previous claim 39 and is dependent on new claim 41.

New claim 48 replaces previous claim 40 and is dependent on new claim 41.

New claims 49-51 are dependent on new claim 41.

New claim 52 is an independent claim.

New claims 53 and 54 are dependent on new claim 52 and are analogous to claims 42 and 43, respectively.

New claim 55 is dependent on new claim 52 and is analogous to claim 44.

Support for the foregoing claims is clearly evident from the previous claims, as well as the present specification.

With respect to claim 47, support is particularly evident e.g. from page 18, lines 5-10 and page 28, lines 15-18.

With respect to claims 49 to 51, support is particularly evident e.g. at page 32, lines 10 to 13.

The significance of the new claims will become further apparent from the remarks below.

The Final Rejection dated January 29, 2004 has rejected previous claims 29-40 under 35 U.S.C. 103(a) as being unpatentable over Hojo et al. (U.S. 5,824,113) in view of Thorsen (U.S. 4,189,303).

This rejection is respectfully traversed.

1. With respect to Hojo et al.

(1) Hojo et al. (U.S. 5,824,113) discloses the method of modifying keratin fiber as summarized below:

Mechanical force is applied to the keratin fiber in the presence of an aqueous solution of a transition metal salt to weaken and destroy the structure of the parts under the keratin layers in scales (surface cells) so that the transition metal may be introduced in the under-keratin layers locally at a high concentration;

the keratin fiber is immersed in a bath containing oxidizing agents such as hydrogen peroxide and monopersulfuric acid;

the oxidizing agents are decomposed by catalytic effect of the transition metal;

mainly due to pressure of oxygen gas evolved by the decomposition keratin layers, which are scales on the keratin fiber, are peeled off.

(2) Hojo et al is completely unsuggestive of the present invention in the modified product and the modifying method as follows:

(a) Hojo et al. uses a transition metal salt (for example, claim 2, col. 10, lines 48-50), whereas the present invention does not.

(b) Hojo et al. applies mechanical force * to keratin fiber in the presence of an aqueous solution of a transition metal salt (claim 1, col.10, ln. 26-36) (EXAMPLE 1, col.6, lines19-20 etc.), whereas the present invention does not.

With respect to the oxidizer, especially to KMnO_4 , the transition metal salt in Hojo et al. is used as a catalyst to decompose an oxidizer (such as H_2O_2), whereas KMnO_4 is used as an oxidizer itself in the present invention.

(c) Hojo et al. uses one step oxidation, whereas the present invention includes two step oxidation and a one reduction step. The -S-S- bond is not cut until the reduction process is carried out. Thereby, the present invention can provide excellent shrink proofing as specified in the present specification (see page 18, line 1 to page 19, line 3 and page 31, line 18 to page 32, line 20).

(d) Hojo et al. carry out the oxidation process under conditions of pH 7.5 to 10.5 (col. 4, lines 30 to 35 and col 10, lines 56 to 57) while the present invention carries out both the first and the second oxidation steps under acidic conditions (p. 26, lines 8-19 and p. 30, line 19 to p. 31, line 17).

The acidic conditions carried out in the primary oxidation process are employed to provide weak-oxidizing conditions so that the -S-S- bond in the cuticle layers may be oxidized to substantially mono oxidized state and not to substantially di-, tri, or tetra oxidized state.

Hojo et al., however, carry out the oxidation process under alkaline conditions to exhibit strong oxidizing power (Hojo et al. col. 4, lines 33 to 35).

2. With respect to Thorsen and non-obviousness:

(1) Thorsen discloses that proteinaceous animal fibrous materials are shrinkproofed by contacting the material with an aqueous solution of ozone.

Thorsen uses ozone dissolved in water (column 3, lines 21 to 35 and col. 6, lines 29 to 31).

The present invention disperses ultrafine bubbles of an ozone/oxygen-mixed gas (e.g. 5 µm or less) in water (see claims 41 and 50). The primary oxidized fiber is subjected to gas-solid oxidation reaction.

Thorsen carries out oxidation under neutral conditions (col. 6, lines 32 to 34).

Thorsen discloses a one-step oxidation process only. Thorsen neither discloses two step oxidation process nor reduction process of the oxidized fibers as specified in the present invention.

As can be seen from the Tables in columns 5 and 6 in Thorsen, ozone concentration dissolved in water shows a very low value of 9 to 14 mg/L, while Hojo et al. uses a 30 % aqueous solution of hydrogen peroxide (concentration 35 %) (col. 6, lines 24 to 25 in Hojo et al.).

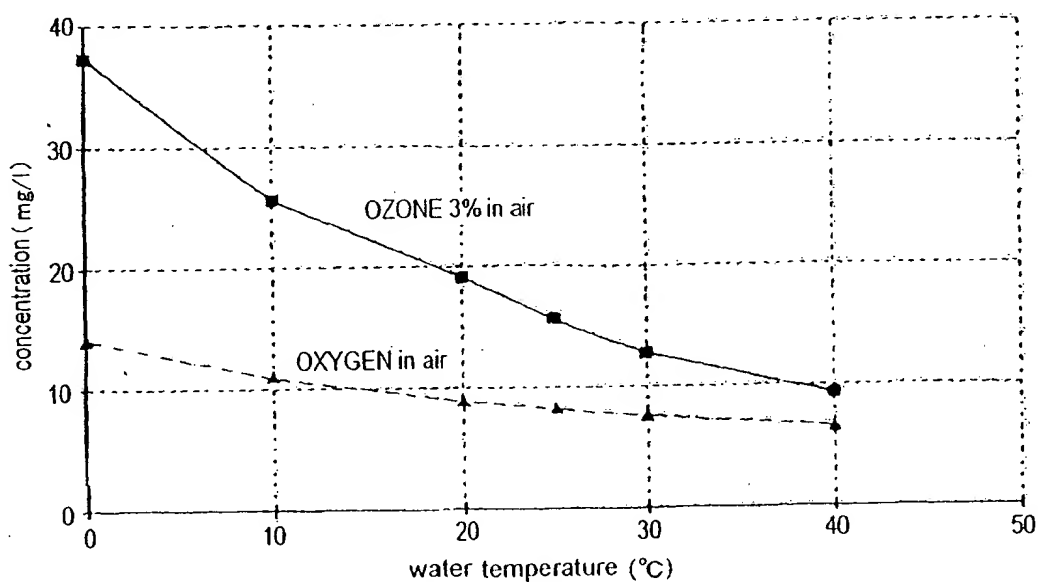
Such a low concentration of ozone as Thorsen employs could not achieve Hojo's aim, which is to generate pressure of oxygen gas evolved by the decomposition so that keratin layers, which are scales on the keratin fiber, may be peeled off.

In addition, Hojo carries out oxidation process under alkaline conditions, being different from the neutral conditions of Thorsen.

Therefore, a person skilled in the art would not be motivated to apply the ozone-dissolved solution of Thorsen to the oxidation process in Hojo et al.

Even if the ozone-dissolved solution of Thorsen is applied to the oxidation process in Hojo et al. provided that Hojo et al.'s invention can be achieved (otherwise, a skilled person in the art would not consider that Thorsen's oxidation process may be applied to Hojo's invention), the obtained process and the obtained product are completely different in that metal transition metal salt, one-step oxidation, no reduction process, results in complete difference of the modified fiber between Hojo et al. and the present invention in morphology, such as configuration and chemical structure, and the physical properties, such as a water repellency, shrink proofing and pilling resistance.

The ozone concentration of Thorsen dissolved in water is not a particular concentration but an ordinary concentration, because ozone can dissolve in water at such a low concentration as shown in the Figure below, i.e. the solubility of ozone in water is approximately 10 mg/ L at 40°C.



The Official Action recognizes that "in Examples 1-3, Thorsen illustrates proteinaceous fibers contacted with a steam-ozone mixture" on page 5, line 14 to 15 of the Final Rejection issued on January 29, 2004.

Even if the steam ozone is used as the rejection states, the steam has an ozone content of about 10-50 milligrams/liter (mg/l) as low as the ozone oxidation (in column 1, lines 51 to 53 of Thorsen).

Further, as Example 1 discloses "An aqueous solution of ozone containing 10.0 mg/l of ozone was passed into the funnel in the back flow direction at a rate of 31.1 l/min and a temperature of 27°C, the aqueous solution of ozone was used to oxidize animal fiber, being same in use of aqueous solution of ozone in Examples 2 and 3. Thorsen also discloses in SUMMARY OF THE INVENTION that "Of course, the '906 process and the present process also differ in that a stream of steam and an ozone-air (or oxygen) stream are simultaneously impinged upon the fabric in the former method whereas in the latter method the fabric is contacted with an aqueous ozone solution" in col. 3, lines 11 to 17 of Thorsen. Therefore, Thorsen's invention is that animal fibers are oxidized in an aqueous solution of ozone.

Neither Hojo et al. nor Thorsen disclose anywhere that the oxidized cystine bonding -S-S- is subjected to reduction reaction and cleaved to form a specified amount of -SO₃H and -S-SO₃Na measured by FT-IR.

As shown in Example 1 and comparative Example 2 in Table 1, page 46 in the present specification, a mere oxidation by ozone cannot achieve the shrink proofing properties of the present invention even if the proteinaceous fibers are subjected to reduction reaction.

The rejection states "In Examples 3 and 6, Hojo et al. illustrate the use of a NaCO₃ aqueous solution and the use of NaOH for the purpose of removing the water repellent keratin scales." The purpose of use of NaCO₃ or NaOH is to provide an alkaline solution pH of which is adjusted to 10.3 or 9.0 in which oxidizing agents, i.e. hydrogen peroxide or monopersulfate (PMS) can react vigorously with transition metal catalyst at the incorporated region in non-keratin endocuticle layers or CMC in order to generate oxygen gas for peeling off keratin layers. Hydrogen peroxide and monopersulfate (PMS) are unstable in aqueous alkaline conditions and are liable to decompose to generate oxygen gas. NaCO₃ or NaOH does not have reduction ability.

3. The difference of morphology of the product between Hojo et al. (even if combined with Thorsen) and the present invention is explained below.

(I) CONSTITUTION OF EPIDERMIS IN WOOL

The constitution of Epidermis in wool fiber is shown Fig. 1(A) - (C) below.

Fig. 1(A)

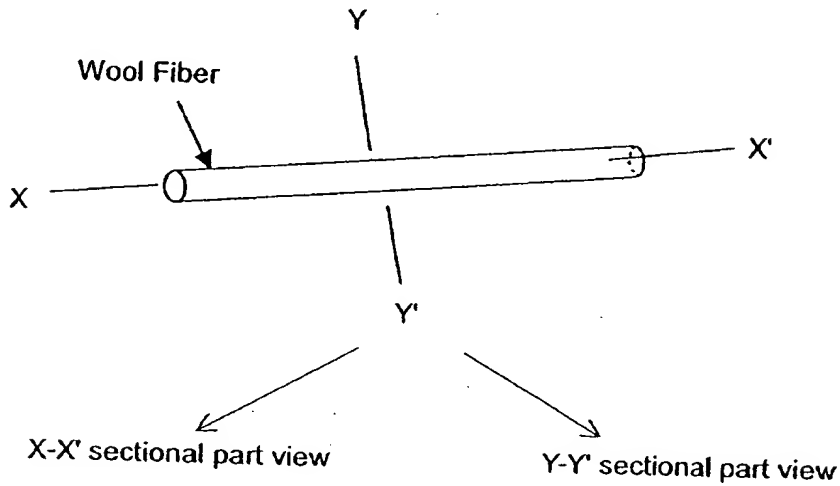


Fig. 1(B) (X-X' sectional view)

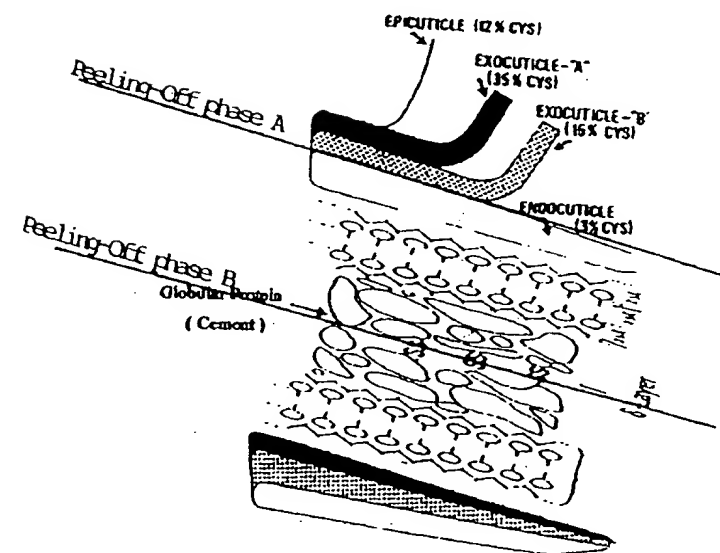
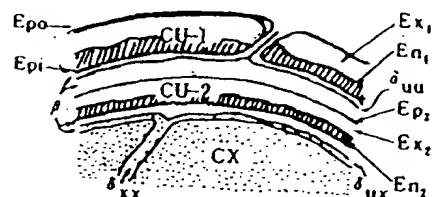


Fig. 1(C) (Y-Y' sectional view)



- Cu-1...first cuticle
- Cu-2...second cuticle
- Ex...Exocuticle
- En...Endocuticle
- Epo, Epi...outer side Epicuticle
inner side Epicuticle
- CU-, cuticle ; CX-; cortex
- β, hydrophobic membrane and space
- δ, fillings between cells

Brandbury, Baumann et al. report morphological components in wool proteinaceous chemical components as below.

Table 1-1 Morphological Components in Merino Wool^{a)}

| Component | Percent in fiber (mass%) | Cystine crosslink content (mol%) ^{b)} | Remarks |
|---|--------------------------|--|------------------|
| Cuticle | | | |
| Epicuticle | 0.1 | 6.0 | Keratinous |
| Exocuticle | 6.4 | 10.0 | Keratinous |
| Endocuticle | 3.6 | 1.6 | Non-keratinous |
| Cortex | | | |
| Macrofibrils | 74.0 | 7 | Keratinous |
| Nuclear remnants + intermacrofibrillar material | 12.6 | 1.6 | Non-keratinous |
| Cell membrane complex | | | |
| Lipid | 0.8 | | Nonproteinaceous |
| Soluble protein | 1.0 | 1.1 | Non-keratinous |
| Resistant membrane | 1.5 | 5.0 | Keratinous |

a) From Bradbury^{3,4)} and Baumann⁶⁾

b) Calculated as cystine + (cysteic acid)/2⁶⁾

J.H.Bradbury, Advan. Protein Chem., 27, 111(1973)

H.Baumann, Fibrous Proteins, Vol.1 (D.A.D.Parry, L.K.Creamer Eds.)
Academic Press, New York p299(1980)

As understood from Table 1-1, Epicuticle and Exocuticle are keratinous. Endocuticle is non-keratinous.

(2) WOOL OF HOJO

Hojo peels off keratin layers (epicuticle layer and exocuticle layer) in scales and endocuticle layer remains, because Hojo describes "The method of this invention enables removal of keratin layers from the scales (outer surface cells)" on lines 10 -12 in column 1 of Hojo, "to cause a rapid reaction at the under-keratin layers so that the keratin layers may be removed from the under-keratin layers and the non-keratin protein layers may be exposed" in col. 3, lines 22 to 26 of Hojo, "The method of modifying keratin fiber represented by wool according to the present invention enables peeling off the keratin parts which form scales without damaging the non-keratin protein of the wool" in column 5, lines 59 to 62 of Hojo, "Wool fiber was dispersed

in the solution and it was appreciated that the water-repellent keratin parts fell off from the fiber" in Examples 1 on lines 31 to 32 in column 6 of Hojo, "it was appreciated that the surface of the fabric became hydrophilic" in Example 2 in column 7, lines 30 to 31 of Hojo, "the wool fiber became hydrophilic and dispersed in the solution. This shows that the water repellent keratin scales of cuticular cells peeled off" in Example 3 in column 8, lines 5 to 7 of Hojo, "Complete removal of the keratin in cuticles was ascertained by microscopic observation of the fiber" in Example 4 in column 8, lines 41 to 42, "keratin of the cuticles completely fell off" in Example 5 in column 9, line 2 of Hojo, "This showed falling off of the water repellent keratin parts" in Example 6 in column 9, lines 34 to 35 of Hojo, and "Bubbles occurred actively and the bath became turbid and turned brown, which seemed to prove peeling off of the keratin layers" in Example 7 in column 10, lines 10 to 12 of Hojo.

The rejection asserts that the teaching of Hojo et al. illustrate removal of the keratin layer and the OPTIONAL removal of the under-keratin layer the property of water repellency is not wanted in the fabric. Please see Examples 3 and 6 and part c) in col. 3.", on page 4, lines 14 to 19 on page 4 in the Final Rejection of January 29, 2004.

Even Examples 3 and 6 indicated by the Examiner do not show optional removal as stated above.

The removal of the under keratin layer is not optional as stated by the rejection, but is rather the purpose and means of Hojo's invention. At least some keratin layers (epicuticle layer and exocuticle layer) in scales are peeled off and endocuticle layer is exposed in Hojo. Otherwise, Hojo cannot achieve the aims and effects of his invention.

Hojo's invention has effects of not only shrink-proofing, but also antibacterial activity. No removal of keratin layers is disclosed anywhere and is not within Hojo's invention.

As stated in column 1, lines 15 to 21, "Felting, which is a drawback of wool, results from the deformation caused by the difference in swelling extent due to the difference in water absorbability of keratin layers and non-keratin protein layers constructing the cuticular cells which make-up to the keratin fibers. Various improved methods have been tried to remove the surface cells." Thus, Hojo belongs to the field in which the shrinkproofing effect is achieved by removing keratin layers, contrary to the present invention.

As Hojo also describes, "wool will obtain various useful properties such as antibacterial activity by being subjected to the treatment comprising removing keratin or exocuticles which form the outmost sides of the surface cells of wool fiber to expose endocuticles which are of hydrophilic non-keratin protein" on lines 45 to 50 in column 1. This antibacterial activity can not be obtained unless the hydrophilic endocuticle layers are exposed by removal of keratin layers.

Hojo discloses the invention corresponding to the cited Hojo Patent (U.S. 5,824,113) in 1) H. Hojo and T. Ogura, Proc. 9th Inter. Wool Text. Res. Conf., Biella, Vol. 1, 217 (1995), 2) H. Hojo and M. Kamada, Proc. 8th Inter. Wool Text. Res. Conf. Christchurch, Vol. IV, 390 (1990).

The references above were attached to the Response of March 31, 2003 and another copy is enclosed for the Examiner's convenience with PTO-1449.

As can be seen, Hojo refers in above reference 1), for example, to "destroy the structure of parts under the exo-cuticle (ex-CU) layer in cuticular (CU) cells" on lines 2 to 3 in the SYNOPSIS and "EX-CU removed wool in Fig. I to Fig.IV. Hojo also refers in reference 2), for example, to "Effects of Removing Exocuticle" in Table III, "EX removed wool" in Fig. 3 and Fig. 4.

It is clear that the removal of some or all keratin layers is essential in Hojo et al., in contrast to the wool of the present invention as discussed below.

(3) WOOL OF THE PRESENT INVENTION

In the present invention, the keratin layers (epicuticle layers and exocuticle layers) are not removed. The configuration of keratin layers are not changed in the present invention but the chemical structure is modified to cut the cystine-S-S- bond. The animal fiber of the present invention which is superior in shrink proofing and pilling resistance is mainly realized by a chemical modification of the epidermal tissue, and the swelling properties of the exocuticle B-layer and the endocuticle layer are made virtually equal to each other, with the water repellence property of the uppermost surface being maintained so that, even when dipped into water, the rising of the scales is virtually eliminated.

In other words, while the integral structural body of the epicuticle layer and the exocuticle A-layer that is a hard structure in terms of higher density of cystine cross linkage is maintained, that

is, while water repellency is maintained, only the exocuticle B-layer is selectively attacked so that its cystine bond, that is, its cross-linking structure, is broken. Only the portions of the surface of the fiber, especially those related to swelling and shrinkage, are subjected to the modification as specified in the claims, with the inside of the fiber being protected; therefore, the resulting feature is that the water repellence property of the entire fiber is maintained and the fiber strength is also maintained and the endocuticle layer is not exposed (page 6, lines 2 to 12; page 15, line 9 to page 16, line 2; page 20, lines 3 to 22; page 31, line 25 to page 32, line 9 and page 35, line 22 to page 36, line 5 of the present specification).

The animal fiber of the present invention has scales in the original configuration of the fiber and cystine -S-S- bond is oxidized and reduced in an epidermal cell of the animal fiber to show such a chemical structure to have not less than 0.1 of relative absorbance in an absorption band of -SO₃H group and not less than 0.08 of relative absorbance in an absorption band of -S-SO₃Na group (Bunte salts) with an absorbance of an absorption band corresponding to amide I set to 1 in a reflection FT-IR measuring method. Thereby, the modified fiber according to the present invention can have excellent water shrinkproofing properties, pilling properties and water repellent properties that the animal fiber originally possesses, at the same time.

Hojo's invention cannot achieve the water repellence property because the keratin layers are removed and the surface of the fibers are hydrophilic as described above.

Water repellent property affects hygroscopicity and moisture releasing property and for controlling heat transfer accompanied by adsorption and desorption of water, and exerts an influence on heat retaining properties and comfort. In other words, the conventional shrink proofing product (including Hojo's invention) can prevent shrinkage (but not very well) from the practical viewpoint compared to the test method of Woolmark Test Method 31 by aqueous washing, but lacks heat retaining property and comfort.

The scale structure with epicuticle layer, exocuticle layer and endocuticle layer incorporated and not destroyed is shown in the present specification as below:

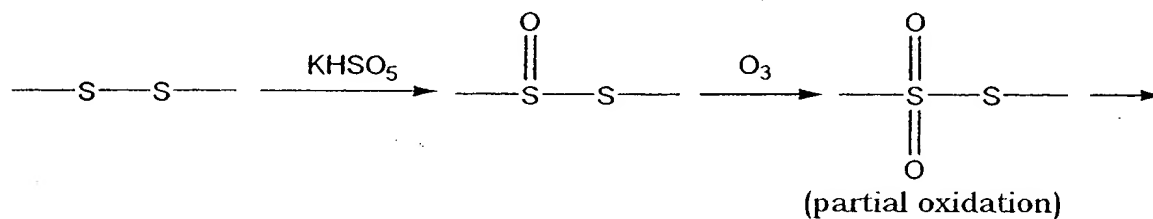
1) evaluation of water repellency by sink-float method to show existence of epicuticle layers (on page 12, lines 19 to 25 and Table 1 on page 46 of the present specification),

2) Allwörden reaction test to show existence of epicuticle layers (on page 12, line 26 to page 13, line 4, page 49, lines 10 to 17 and Fig. 6).

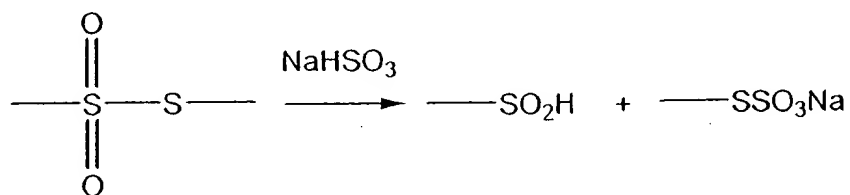
3) photographs of a Scanning Electronic Microscope in Fig. 2 show the same surface of wool fiber of the present invention as the surface of untreated wool fiber.

In the present invention, the density of cystine crosslinked bond (-S-S-) in cystine is reduced by the two step oxidation process and reduction process as shown below, and the difference in water-swelling rate between exocuticle layer and endocuticle layer is made small, so that arising of scale edge in water can be eliminated.

The present invention pre-oxidizes animal fibers with, for example, potassium hydrogen monopersulfate (PMS), cystine crosslinked bond (-S-S-) is stopped at substantially mono-oxidized state, and is further oxidized to higher order using ozone bubbles in the subsequent step (page 21, line 4 to page 31, line 17).



At this oxidation stage, cystine crosslinked bond (-S-S-) is not cleaved in but just partially oxidized. In this partially oxidized state, shrink proof effect can not be obtained. Shrink proof effect can not be obtained until reduction treatment is made to cleave cystine crosslinked bond (-S-S-) (on page 31, line 18 to page 32, line 20).



(reduction process)(-S-S- bond fission)

Unless animal fiber is treated to this stage, shrink proof effect cannot be attained in addition to water repellency. This fact is shown in Example 1 and comparative Examples 1 and 2 in Table 1, page 46 in the present specification. Mere oxidation by PMS or ozone bubbles can not achieve the

shrink proofing properties of the present invention even if the proteinaceous fibers being subjected to reduction reaction.

The animal fiber thus obtained can be identified by FT-IR to measure an absorption band of the $-SO_3H$ group and an absorption band of $-S-SO_3Na$ group (Bunte salts) with an absorbance of an absorption band corresponding to amide I set to 1 in a reflection FT-IR measuring method" (on page 16, lines 3 to 19).

With respect to the modified product, it is clearly shown by the declaration pursuant to 37 C.F.R § 1.132 of record on April 28, 2004 that the modified product of the present invention is completely different in morphology and physical properties from that of Hojo et al.

4. Next, reference is made to the Felt shrinkage test carried out in the present invention. The shrinkage test used in the present invention is a much more severe test than those used in Hojo et al. and Thorsen. Thorsen carried out shrinkage test in accordance with AATCC Method 124-1973 (column 4, line 50). It is well known in the art that this AATCC Method 124-1973 is not practical to evaluate shrinkage properties from the viewpoint of practical use. And the conditions of the shrinkage test in the present invention is made more severe by modifying WM TM31 method (Wool Mark Test Method 31) as described below.

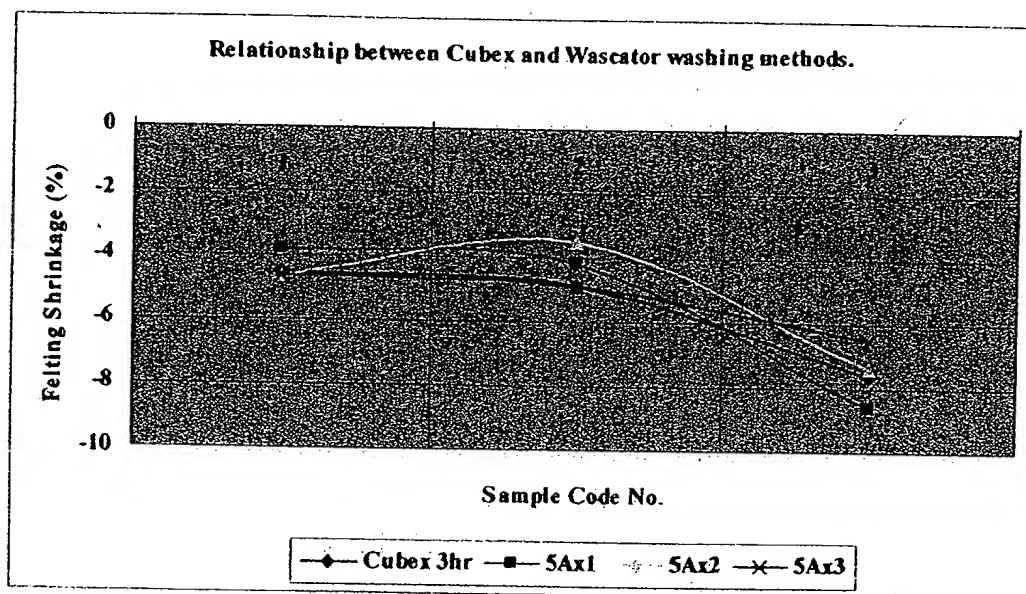
It is described in the specification with respect to shrinkage test that (1) "area shrinkage rate of not more than 8 % in a three-hour aqueous washing when measured as a felting shrinkage rate in conformity with Wool Mark Test Method 31 "(page 6, lines 14 to 18 of the specification), (2) "the felting shrinkage rate is measured in conformity with WM TM31 method (Wool Mark Test Method 31), and a fabric knitted into a cover-factor C.F. 0.41 with one thread being taken from 14 gages is used as a sample. Here, "conformity to "WM TM31 method" refers to the fact that the measurements were carried out in accordance with the testing procedure of WM TM31 method set based upon the ISO 6330 method, while the test washing machine was changed to a Cubex shrinkage testing machine." (page 11, lines 7 to 15).

Please refer to the manual of "WM TM31 method" (copy enclosed). The main modification of WM TM31 test in the present evaluation is a washing machine, washing time and washing cycle.

In the present invention, a Cubex shrinkage testing machine was used instead of a Wascator (in WM TM31), the washing time is 3 successive times instead of 12 minutes, and the washing cycle

is one. The modified WM TM31 test in the present evaluation is rather severe compared to the standard WM TM31 test, as shown below.

By using the Cubex (40x40x40 cm³) International Shrinkage apparatus (specified by IWS TM 185/186 in 1981) containing of 15L-aqueous washing liquor, the washing time was selected the condition of successive 3 hours at 40°C from preliminary test results using the knitted fabric shrink-resistant by the present ozone-treatment, which is indicated in the below Figure. That is, the felting potential by the 15L-Cubex ("Cubex 3hr" line in the figure) is roughly the same or is rather severe compared to ISO 6330 A x 1 cycle ("5Ax1" line in the figure), ISO 6330 5Ax2 cycle ("5Ax2" line in the figure), ISO 6330 5Ax3 cycle ("5Ax3" line in the figure) of TM31 using a Wascator shrinkage apparatus.



Note: "5A" in the figure means "ISO 6330 5A"

The minus (-) in the figure shows a contraction percentage of the washed knitted fabrics.

Sample code Nos. 1, 2, and 3 in the above figure indicate various samples of the knitted fabric composed of the different twist number of 2/48Nm worsted yarn, but the cover factor of the knitted

fabrics was 0.41 respectively, i.e., yarn twist of No 1. was Z480 x S270, No2 Z480 x S280, and No.3 Z480 x S260. (The higher the S value is, the more tightly the fabrics are twisted.)

5. For the foregoing reasons, the present invention is unobvious from Hojo et al. and Thorsen, alone or combined.


The treatment processes for fibers of Hojo et al. and Thorsen are completely different from that of the present invention. There is no motivation for a person in the art to apply Thorsen to Hojo et al. Even if Thorsen were applied to Hojo et al., the combined process would only be the same as that of Hojo et al. at best, being completely unsuggestive of that of the present invention in the process and the obtained product.

No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

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